**Life Support Systems (Lesson 2 of 3)**

**Lesson 2A**

**Functions of Life Support Systems and Carbon Dioxide Conversion**

**STEM Topics -** Climate Change, Global Warming, Carbon Dioxide Capture and Conversion, Life Support Systems in Space, Cleaning with Water Solutions

**Author:** Matt Katterman

**Grade Level:** 6-8 Grade

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**Goals**: Introduce the purpose and function of the Life Support Systems on the space station and carbon dioxide capture and conversion on the space station and on Earth.

**Learning Objectives:**

1. SWBAT know the functions of each life support system and what they are used for.
2. SWBAT learn that carbon dioxide can be captured on the space station and on Earth.
3. SWBAT learn how carbon dioxide capture and conversion can assist towards improving climate change conditions and global warming.

**Materials:**

Instructional Videos:

Carbon Dioxide Gummy Bears.mp4

Power points:

Life Support Systems Matching.pptx

Carbon dioxide capture.pptx

Documents:

Life Support Matching Score Card.doc

Life Support System and Function.doc

Experimental Materials (for each student):

3 500 mL water bottles filled one-third with vinegar.

Two 2 oz cups filled with sodium bicarbonate. One ¼ filled, the other ½ filled.

9 gummy bears. 3 red, 3 orange, 3 yellow.

2 3” x 5” index cards, pen

Scissors, Tape

2 paper cones cut at the bottom.

Demonstration Materials (for each students):

Set of 4 dirty pennies

500 mL water bottle 2/3 filled with vinegar

2 oz container of table salt with lid

Paper towels

Spoon

Two 8 oz plastic cups

Website Game or Activity:

LifeSupportChoose.html

LINK

<http://kattsustaineducation.com.s3-website.us-east-2.amazonaws.com/Games/LifeSupportChoose.html>

**Vocabulary:**

**Greenhouse Gas -** Any gas capable of absorbing infrared radiation (net heat energy) emitted from Earth's surface and reradiating it back to Earth's surface.

**Climate Change -** describes a change in the average conditions — such as temperature and rainfall — in a region over a long period of time. NASA scientists have observed Earth’s surface is warming, and many of the warmest years on record have happened in the past 20 years.

**Carbon Capture and Storage -** the process of capturing waste carbon dioxide, transporting it to a storage site, and depositing it where it will not enter the atmosphere.

**Carbon Dioxide Conversion –** The process of capturing carbon dioxide and putting it through chemical reactions that change its form or chemical consistency into another carbon compound.

**Setup:**

1.Review the power point lesson file **Introduction to Life Support Systems.pptx** for the content in the slides. Afterwards look at the **LifeSupportMatch.html** computer activity in order to help the students work with the game after the Introduction to Life Support Systems presentation has been taught.

2.Review the power point lesson file **Water Filtration.pptx** in order to teach the concepts of water filtration as it applies to why astronauts need water filtration for their water and how we clean water on Earth when it is polluted. Afterwards look over the videos **Water and You: The Water Treatment Process**, **Charcoal Water Filtration in English** since these will be played after the lesson. Think of some possible points or questions to ask the students after they have viewed the videos if desired.

3.Get the materials gathered and setup for the water filtration experiment that are listed in the previous materials section so that you can demonstrate the experiment while the students are attempting to perform it. Also make sure your students have all the materials they need before starting the experiment, maybe go through the checklist of materials with them when this part of the lesson starts.

4.Watch the video **Water Filtration cotton balls dirt.mp4** ahead of time to get instruction and ideas for conducting the water filtration activity. While reviewing the video note places to pause the instructional videos for the students (mentioned in the lesson plan procedure) so that they can perform that specific step in the activity. Review the data and results table file **Water Filtration Experimental Table.doc** after watching the video to understand how the students will use it while doing their experiment. Make sure each student has a copy or access to a copy of the experimental table.

5.Gather together the materials for the Acid/Base pH demonstration that will do with the students. Get the various types of liquids a day or two ahead of time and put them in the 2 oz cups the day before. Review the power point presentation file **Measuring Acidity.pptx** in order to know what to present for introducing concepts of acids, bases and pH paper. Next, review the documents **Acidity of Liquids Activity.doc** and **pH colors to numbers.doc** to know how to conduct the demonstration. Use the columns in the Acidity of Liquids to guide you through it where you would first introduce the liquid, have them guess if it’s an acid or base, measure the pH and then write down the result.

**Lesson Plan Procedure:**

1.Start by giving the power point presentation **Introduction to Life Support Systems.pptx.** The presentation should cover the 8 different types of Life Support Systems and how they help astronauts realize their essential activities they do every day. Make sure to tell the students that to pay attention to the pictures and titles of each system as they will be used in the LifeSupportMatch.html game. During the middle of the presentation they should help you fill out the Life Essential Processes and Activities chart on slide #5. Have them guess some of these activities first, give them hints and then fill it out. [15 minutes]

2.Next have the students play the **LifeSupportMatch.html** game where they match the pictures on the right side of the console shown in the Introduction to Life Support Systems to the titles on the left side. [10 minutes]

3.After they have finished the LifeSupportMatch game introduce the water filtration experiment by discussing the **Water Filtration.pptx** power point lesson. Make sure to emphasize why cleaning water is important to astronauts and the activities they do and what specifically filtration cleans in the water. Talk about the importance of eliminating germs, the purpose of the water recovery system and then switch to Earth related water purification by covering the types of pollutants, wastewater treatment plants and then compare to the space station water treatment system. The last slide introduces the concept of doing a water filtration experiment. Mention that they will build a filter after the videos and presentation using a system similar to what is seen in the slide. The goal is to filter dirty water (water with dirt and fertilizer in it).Next, show the two videos **Water and You: The Water Treatment Process**, **Charcoal Water Filtration in English**. Perhaps ask a few questions about the videos or prepare some comments about them [20 minutes].

4.Introduce the water filtration experiment by showing the students the pieces of equipment which are the two cut out half water bottles, coffee filters, cotton balls, sand, fertilizer dirt and spoon. Next, have the students account for their materials by going through the list with them as well. Afterwards, start the instructional video **Water Filtration cotton balls dirt.mp4** to start the experiment and tell them that everyone will view the video while doing the experiment in different parts. The parts of the video are listed below or the points where you pause and do certain steps.

5.Go over and show the materials for the experiment (0 to 2:50). Label the bottles with amounts of filtration media for each (cotton balls and sand) (2:50 – 5:09). Insert coffee filters in each set of bottles (5:10 – 6:42). Place two scoops of dirt into each bottle as a bottom layer (6:43 – 7:34). Put in 2 cotton balls and 4 scoops of dirt in first bottle (7:35 – 8:22). Put in 4 cotton balls and 2 scoops of dirt in the second bottle (8:23 – 9:20). Mix fertilizer dirt with water (9:21 – 10:40). Add dirty water into each of the filter bottles with media and let the water filter out (10:41 – 12:30). Fill out data observation table (12:31 to 14:24). [45 minutes].

6. Next, introduce the acid/base pH measurement demonstration with various liquids. Show all 8 types of liquids, what each one of them is and then show the pH paper. Explain briefly what the demonstration does with the pH paper. Afterwards initiate an introduction into the topic by showing the **Measuring Acidity.pptx** power point presentation. Make sure to talk about the different types of filtration and how contaminants can be clear and are harder to filter out. Talks about what makes liquids acidic or basic, why this is important and how microbes and algae live in certain different pH ranges. Next, cover what an acid and a base are, and then measuring pH with paper and cover what the pH scale is.

7. Start the demonstration by showing the different liquids again with the pH paper. Next show the **Acidity of Liquids Activity.doc** data table and briefly explain what you will do with each of the liquids listed in each row. Tell them you are going to ask them to guess whether the liquid is an acid or a base first. Then you will measure the pH of the liquid, note the color of the paper and write that down. Next, show them the **pH colors to numbers.doc** picture and let them know you will refer to it in order to get the specific pH of the liquid and whether it is acidic or basic. Afterwards you will write down that pH value and if it is an acid or base in the last column. Follow this procedure for each of the 8 liquids that you will demonstrate on. [30 minutes]